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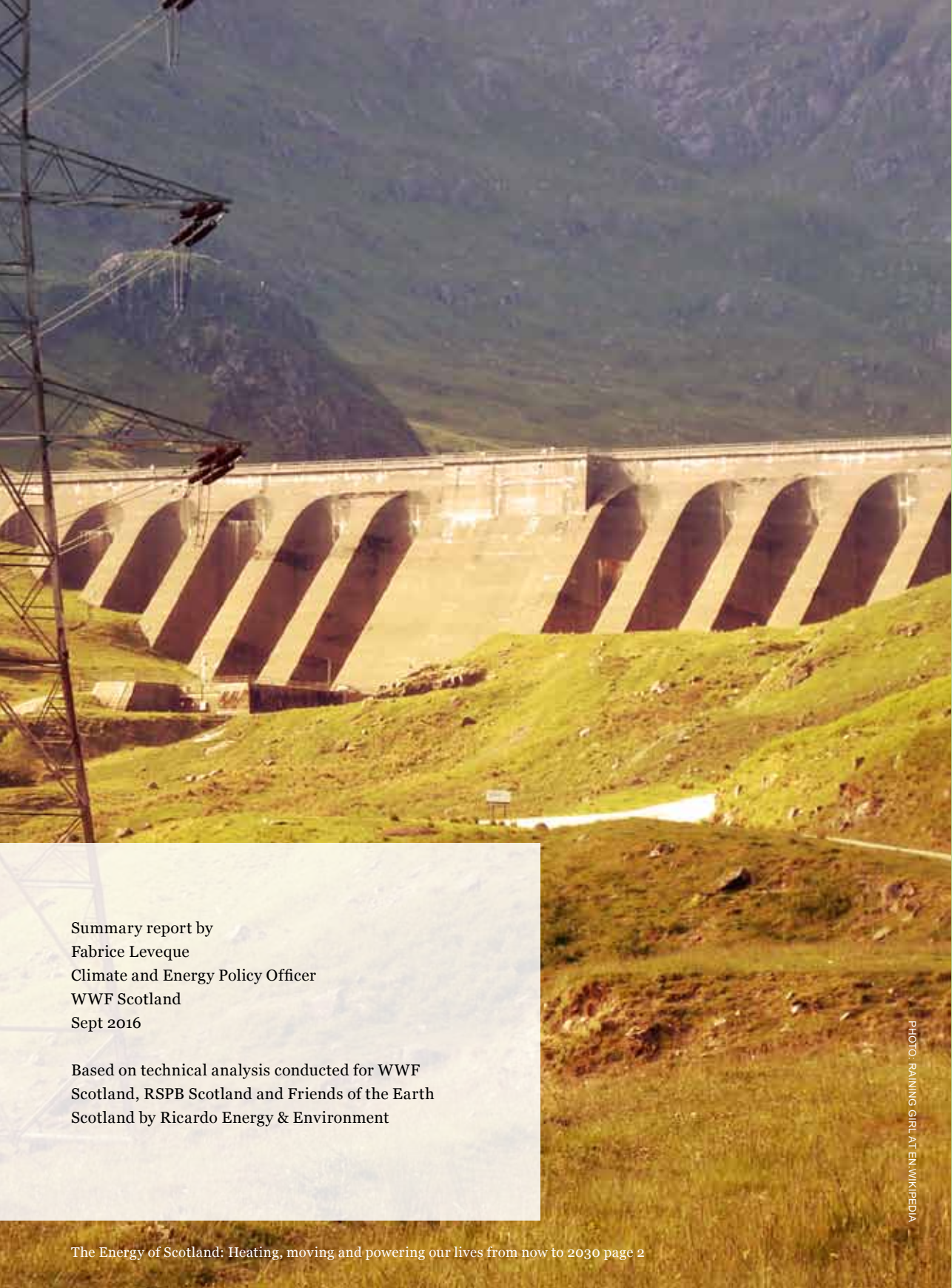
**Friends of  
the Earth  
Scotland**



giving  
nature  
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# THE ENERGY OF SCOTLAND:

HEATING, MOVING AND POWERING  
OUR LIVES FROM NOW TO 2030



Summary report by  
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Based on technical analysis conducted for WWF  
Scotland, RSPB Scotland and Friends of the Earth  
Scotland by Ricardo Energy & Environment

PHOTO: RAINING GIRL AT EN.WIKIPEDIA

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THIS REPORT SETS OUT THE SCALE OF DEVELOPMENT THAT SCOTLAND MUST EMBRACE IF IT IS TO RETAIN ITS PLACE IN THE GLOBAL VANGUARD OF THE ENERGY TRANSITION

# WELCOME TO OUR FUTURE

Scotland is in the enviable position of having fantastic renewable energy potential.

Successfully unlocking this potential will not only secure our climate goals but provide the means to deliver economic opportunities across Scotland, bring social benefits and improve public health.

Much has been achieved already. At last count Scotland generated the equivalent of 57% of its electricity consumption from renewables and had reduced climate emissions by 39.5% since 1990.

This is a tremendous achievement, but there are no grounds for complacency.

In 2016 the Committee on Climate Change provided advice on Scotland's next set of climate targets, recommending that a 66% reduction in gross emissions be achieved by 2030. WWF Scotland, together with RSPB Scotland and Friends of the Earth Scotland commissioned Ricardo Energy & Environment and University College London to look specifically at what is required of the energy system – in particular heat, transport and electricity – to meet this ambition.

Their analysis adopted a globally-recognised energy system model which takes into account all energy sectors and the interactions between them.

The model was cost-optimised, and therefore offers suggestions on the least-cost route to achieve Scotland's carbon reduction goals.

The conclusion of their report is clear: by 2030, at least 50% of Scotland's energy will need to come from renewables. We will need to make significant changes to the way we heat our homes and organise our transport, alongside year-on-year reductions in energy demand, to be on track to delivering this low-carbon economy.

New, bold policies will be needed, along with a whole systems approach that has all sectors playing a part and recognises the interactions between them.

Achieving this will require strong leadership and concerted action. The Scottish Government's forthcoming energy strategy is a welcome opportunity to set out a clear vision for the future and describe how it plans to assert control over Scotland's energy transition and thereby capture the many benefits on offer.

This report sets out the scale of development that Scotland must embrace if it is to retain its place in the global vanguard of the energy transition, and in the process create a thriving, healthy, economically-active low-carbon society.

*Lang Banks, Director  
WWF Scotland*

# EXECUTIVE SUMMARY

2030 will be an important milestone on Scotland's journey to a low-carbon economy.

Independent analysis by Ricardo Energy & Environment shows that to deliver Scotland's climate targets at lowest cost and maximum benefit, a minimum of 50% of our energy across the electricity, heat and transport sectors will need to come from renewables by 2030<sup>1</sup>. On our current trajectory, less than 30% will be achieved, and climate targets will be missed. Our evidence illustrates how this low-carbon future is both achievable and desirable, poses a low risk to wildlife, and sets out the actions needed to realise it.

## THE VISION

By bringing in policies to meet Ricardo Energy & Environment's analysis, Scotland in 2030 will have achieved a low cost, maximum benefit energy transition.

In 2030:

**Energy efficiency:** is the bedrock of carbon reduction, with total energy demand 20% lower than today thanks to buildings, products and vehicles that do more for less. Buildings deliver the bulk of the savings, thanks to a major energy efficiency upgrade which tackles fuel poverty, improves health and creates thousands of jobs.

**Heat:** renewables supply 40% of Scotland's heat in 2030, up from 4% today<sup>2</sup>. Heat pumps are routinely installed in offices and homes, and district heat networks have expanded in cities. The renewal of Scotland's heat infrastructure helps tackle fuel poverty and provides jobs across the country.

**Electricity:** Scotland capitalises on its tremendous natural resources, generating the equivalent of 143% of electricity demand from renewables, with substantial exports to the rest of the UK. An additional 7 - 8 GW of new renewable capacity<sup>3</sup> is built, security of supply is maintained and up to 14,000 new jobs are created.

**Transport:** low emission vehicles are mainstream. Half of buses and one in three cars is electric, with 18% of transport energy coming from renewables. Public health is improved thanks to investment in walking and cycling in towns and cities, and a 40% drop in the use of petrol and diesel that improves air quality in cities.

## THE ACTION

The key policies the Scottish Government must bring forward to deliver this vision are:

**A 2030 renewable energy target:** to source at least 50% of Scotland's energy from renewables by 2030, with individual targets for each of the heat, transport and electricity sectors.

**Energy efficiency:** Scotland's Energy Efficiency Programme must be provided with multi-year funding to deliver at scale, supported by regulation of minimum standards to drive uptake, and an overall target that is consistent with Scotland's Climate Change Act.

**Heat:** New legislation must be introduced to create the regulatory framework that can support the rapid growth of district heat networks across Scotland. New buildings must be zero-carbon and heated by renewables.

**Electricity:** new mechanisms must be found to replace UK Government market support, both for new renewable projects and the repowering of existing ones, alongside greater investment in system flexibility such as energy storage, interconnection and demand-side response.

**Transport:** The Scottish Government should produce a clear vision for a wholly-integrated sustainable transport system, showing how petrol and diesel vehicles will be phased-out and ensuring that public and active transport options can compete with the private car.

The full report by Ricardo Energy & Environment can be accessed here: [wwf.org.uk/renewableenergy2030](http://wwf.org.uk/renewableenergy2030)



# A TARGET FOR AT LEAST 50% OF SCOTLAND'S ENERGY FROM RENEWABLES BY 2030

Bold targets and strong leadership have been instrumental in Scotland's renewable electricity success story. The Scottish Government must build on this by setting a new energy target for 2030, to extend the same vision and drive to all parts of the energy sector.

## WHY NOW?

The analysis by Ricardo Energy & Environment makes clear that expanding Scotland's use of renewable energy from 13% today<sup>4</sup> to 50% by 2030<sup>5</sup> is a cost-effective route to meeting climate targets that will bring many benefits.

The study looked at each sector, and found that this is achievable and economically, socially and environmentally desirable. It recommends that Scotland continues to build on strong progress in renewable electricity, generating additional power for use in the transport and heat sectors, complemented by greater action on energy efficiency.

## BENEFITS

A bold vision and strong leadership is required to make this transition happen and allow Scotland to reap the benefits. For example, the Scottish Government's renewable electricity target for 2020<sup>6</sup> set out an ambitious but realistic vision for growth. Research conducted on behalf of WWF Scotland found that this target was a significant factor in determining planning policy, funding support, economic strategies and the skills agenda. This approach gave the targets substance and credibility to investors, industry and political leaders, and gave a sharp focus to realising the ambition.<sup>7</sup>

## ACTIONS

The Scottish Government should set a target to source at least 50% of Scotland's energy from renewables by 2030, with individual targets for each of the heat, transport and electricity sectors. New targets should be accompanied by a roadmap showing how they can be achieved, and the policies that will deliver them. The 2020 renewable electricity target provided clarity and focus, and must now be extended to ensure we plan, prepare and deliver the significant changes required.

## KEY NUMBERS

**143%**  
OF ELECTRICITY  
CONSUMPTION FROM  
RENEWABLES

**40%**  
OF HEAT FROM  
RENEWABLES

**18%**  
OF TRANSPORT POWERED  
BY RENEWABLES

# TIME TO CLOSE THE POLICY GAP

Current policies will not be enough to meet Scotland's future climate targets. Bold action is needed in new areas to extend the economic and social benefits of a low-carbon transition to all parts of Scotland's economy.

## THE CHALLENGE

The measures in place and proposed in the Scottish Government's Second Report on Proposals and Policies (RPP2) - Scotland's Climate Change Plan - whilst welcome, are not sufficient to meet future climate targets, with policies in the RPP2 falling short of the 2030 target by around 30%.

Scotland's good progress in reducing emissions, which have fallen by 39.5% since 1990, has largely been driven by reductions from a few sectors, notably electricity and waste. However, the remaining potential to reduce emissions in these areas will quickly be exhausted. It now falls to other sectors to step up and play their part, in particular transport, where emissions have fallen less than 1% since 1990<sup>8</sup>, and buildings, where progress on energy efficiency and heat has been slow<sup>9</sup>.

## BENEFITS

The changes afforded by a low-carbon Scotland are at very least cost-neutral<sup>10</sup>, with very significant upside opportunities to create new jobs and economic activity, improve health and well-being, tackle inequalities like fuel poverty, improve infrastructure and reduce Scotland's reliance on dwindling and volatile fossil fuel supplies.

## ACTIONS

The benefits of climate action won't be realised without active policy intervention: government needs to show leadership and be assertive to disrupt the status quo. Leadership will be required from across the Scottish Parliament to ensure that the third Report on Proposals and Policies (RPP3) provides industry with confidence and direction. A clear direction of travel is required now to ready consumers, supply chains, products and markets for the significant improvements that will need to take place in the 2020s.

## KEY NUMBERS

**66%**  
GROSS EMISSIONS  
REDUCTION REQUIRED  
BY 2030

**50%**  
GROSS EMISSIONS REDUCTION  
ACHIEVED BY CURRENT  
POLICIES IN 2030





# SCOTLAND IN 2030: ENERGY EFFICIENCY DELIVERS

In 2030 buildings, products and vehicles do more for less. Energy efficiency is the bedrock of carbon reduction, no more so than in buildings, where a major energy efficiency upgrade has taken place, ending the scourge of cold homes in Scotland.

## THE VISION

Energy efficiency provides a 20% reduction in energy demand by 2030, primarily through more efficient buildings, vehicles and electricity-consuming products.

This is achieved by a major programme to retrofit insulation to existing homes and buildings, which reduces domestic energy demand by 30% by 2030. New buildings are constructed to high standards of energy efficiency, and more efficient products such as LED lighting reduce electricity demand, making renewable generation go further.

## THE BENEFITS

Retrofit energy efficiency turns cold houses into warm homes, lowering energy bills and eradicating fuel poverty once and for all. The NHS saves an estimated £48m – £80m<sup>11</sup> a year as illnesses caused by cold and damp are reduced, and 8-9,000 jobs are created right across Scotland<sup>12</sup>. Making homes more efficient prepares them for renewable heating, especially heat pumps.

## ACTIONS

Good progress to date has been driven by EU regulations on products and vehicles, but our homes continue to lag behind. Scotland's new energy efficiency programme must set an overall target that is consistent with Scotland's Climate Change Act and provided with multi-year funding to deliver at scale. Uptake should be driven by regulation of minimum standards, supported by grants and loans offered to all households. New buildings must be zero-carbon, and the market for more efficient lights and appliances should be stimulated with a new funding competition for businesses and the public sector.

## KEY NUMBERS

**845,000**

THE NUMBER OF HOUSEHOLDS  
LIVING IN FUEL POVERTY IN  
SCOTLAND IN 2014<sup>13</sup>

**30%**

REDUCTION IN THE DEMAND  
FOR HEAT FROM HOMES BY  
2030

**8-9,000**

NEW JOBS CREATED ACROSS  
SCOTLAND





# HEAT: A MAJOR TRANSFORMATION UNDERWAY

In 2030 over half of all buildings are heated by renewables. Heat pumps are routinely installed in offices and homes and district heat networks have expanded in cities. The renewal of Scotland's heat infrastructure is providing jobs across the country.

## THE VISION

Ricardo Energy & Environment's analysis shows that renewables must provide 40% of Scotland's heat by 2030, up from 4% today, to meet Scotland's climate targets cost effectively.

This is achieved by fitting half of all homes with hybrid (electric/gas) heat pumps<sup>14</sup>. Three quarters of commercial buildings are renewably heated and district heat networks are commonplace, serving homes, businesses and industrial sites. Emissions from industry fall thanks to the use of biogas, biomass and electricity.

## BENEFITS

The renewal of Scotland's heat infrastructure helps tackle fuel poverty by bringing down heating costs. Supply chains are busy delivering both large scale infrastructure like district heat networks, and re-training to install new technologies in individual homes. Our heat system is more efficient, and domestically produced electricity offsets dwindling supplies of gas in Scotland's heat mix.

## ACTIONS

The heat transition has only just begun and it will take bold leadership and action from the Scottish Government to accelerate the pace of change. Regulation is needed to support the growth of district heat networks<sup>15</sup>, and building regulations should require that all newly constructed homes and offices are heated with renewables. An ambitious new energy efficiency programme is needed to prepare homes and buildings for renewable heat systems.

## KEY NUMBERS

**4%**  
OF HEAT CONSUMPTION  
FROM RENEWABLES TODAY

**40%**  
OF HEAT CONSUMPTION  
FROM RENEWABLES IN  
2030

**£600 -  
1000m**  
POTENTIAL INVESTMENT  
IN HEAT NETWORKS BY  
2020<sup>16</sup>



# ELECTRICITY: CONTINUED GROWTH

In 2030 Scotland is capitalising on its tremendous natural resources, generating the equivalent of 143% of electricity demand from renewables, with substantial exports to the rest of the UK.

## THE VISION

Ricardo Energy & Environment's analysis shows that emissions from the power sector fall to near zero by 2030, with output increasing to provide electricity for use in transport and heat.

An additional 7 - 8 GW of new wind<sup>17</sup> capacity (on or offshore) is built<sup>18</sup> to replace retiring nuclear and meet increasing demand from other sectors so that by 2030, renewables generate 143% of Scotland's electricity demand, with the excess exported to the rest of the UK<sup>19</sup>. The generation mix is almost entirely renewable whilst security of supply is maintained by enhanced grid flexibility, energy storage and connection to wider UK and European electricity grids<sup>20</sup>.

## BENEFITS

The new capacity in this scenario creates 14,000 more jobs, with local communities benefiting from new income and investment opportunities. Scotland's energy security is enhanced as dwindling domestic supplies of fossil fuels are replaced with domestic renewables.

## ACTIONS

Renewable electricity has been one of the early success stories of Scotland's low-carbon story, bringing new jobs and cleaner air. Whilst there is sufficient wind power already operational, consented or in planning to deliver this scenario, new mechanisms will need to be found to replace UK Government support, both for new projects and the repowering of existing ones. More system flexibility will be needed, requiring investment in energy storage, interconnection and demand-side response enabled by smart meters.

## KEY NUMBERS

**Zero**


NEW FOSSIL FUEL OR  
NUCLEAR PLANTS

**7 - 8 GW**

RENEWABLE CAPACITY  
ADDED DURING THE 2020S  
ON OR OFFSHORE

**14,000**

MORE JOBS IN  
WIND ENERGY



# TRANSPORT: ONE IN THREE CARS IS ELECTRIC

In 2030 low emission vehicles are mainstream. Half of buses and one in three cars run on renewable electricity, improving the air in our cities and the health of our communities. A fifth of transport energy comes from renewables.

## THE VISION

Ricardo Energy & Environment's analysis shows that emissions from transport must fall by 40% by 2030, with renewables providing a fifth of the energy consumed, up from 4% today.

This is achieved by making vehicles more energy efficient and switching them to run on electricity, with biofuels playing the same role as today. On the roads, half of buses and one in three cars is electric, with investment in walking and cycling in towns and cities reducing congestion. Over half of all new vehicles sold have ultra-low emissions.

## THE BENEFITS

A 40% drop in the use of petrol and diesel improves air quality in cities, resulting in better public health. People are also fitter and healthier thanks to more walking and cycling in renewed cityscapes that are less dominated by cars. There is less congestion, with fewer and quieter vehicles on the road.

## ACTIONS

Scotland's low-carbon transport sector needs to move up a gear to hit future climate targets, with emissions from the sector falling less than 1% since 1990. The Scottish Government must follow the lead of our European neighbours and set out a plan to phase out petrol and diesel vehicles, continue the development of a comprehensive electric charging network, require public transport systems to shift to low-emission vehicles and level the playing field so that public transport, walking and cycling can compete with the private car.

## KEY NUMBERS

1%

FALL IN TRANSPORT  
EMISSIONS BETWEEN 1990  
AND 2014

3

ELECTRIC VEHICLES USE  
THREE TIMES LESS ENERGY  
THAN THEIR FOSSIL FUEL  
COUSINS

50%

OF ALL BUSES ARE ELECTRIC  
BY 2030



# REFERENCES

1. The renewable energy percentage is calculated as the ratio of total renewable energy consumption to total energy consumption, with renewable energy consumption calculated as total renewable electricity production plus total renewable heat consumption plus total renewable transport consumption. This is the method specified by the EU Renewable Energy Directive.
2. Scottish Government (2016) Energy in Scotland
3. In addition to capacity currently installed, under construction or with subsidy contracts
4. Scottish Government (2016) Energy in Scotland
5. The figure in Ricardo Energy & Environment's report is 48%, which we round to up to 50% to leave a margin for error. The report warns that aiming for 44-48% renewable energy risks missing the emissions target should energy efficiency measures fail to be delivered (as more energy input would then be required) or if emissions reductions from non-energy sectors prove harder to deliver.
6. To generate the equivalent of 100% of Scotland's electricity demand from renewables.
7. WWF Scotland (2013) Scotland: A renewable powerhouse
8. Scottish Government (2016) Scottish Greenhouse Gas Emissions 2014
9. Committee on Climate Change (2016) Reducing Emissions in Scotland – 2016 Progress Report
10. The total discounted costs are broadly equivalent to the value of the carbon saved. Benefits calculated according to DECC's carbon valuation toolkit
11. Consumer Futures Scotland (2014) Economic impact of improving the energy efficiency of fuel poor households in Scotland
12. Consumer Futures Scotland (2014) Economic impact of improving the energy efficiency of fuel poor households in Scotland
13. Scottish Government (2014) Scottish House Condition Survey
14. A hybrid heat pump features an electric heat pump complemented by a small gas boiler top-up for very cold periods, helping manage the impact of electric heating on peak electricity demand. If installing only pure electric heat pumps, 28% of homes are required to change heating system by 2030
15. Following the recommendations of the Scottish Government's Special Working Group on (District Heat) Regulation
16. Heat Network Partnership (2015) Investment in Heat Networks in Scotland
17. In addition to capacity currently installed, under construction or with subsidy contracts. Wind energy is selected in this scenario, but in practise this could be delivered by a mix of other renewables including solar and marine.
18. This level of deployment of renewable energy has been demonstrated to be possible at low risk to Scotland's wildlife through spatial analysis undertaken by RSPB, which assumes that developments are sited to minimise risks to sensitive species and habitats
19. The Scotland scenario is part of a full UK model, which finds it cost-optimal to generate additional renewable electricity in Scotland for export to the rest of UK
20. DNV GL (2014) Analysis of implications of a decarbonised power sector in Scotland by 2030 - technical report
21. Committee on Climate Change (2016) Scottish Emissions Targets 2028–2032.
22. Using the 2015 Scottish greenhouse gas emissions inventory

# SCENARIOS

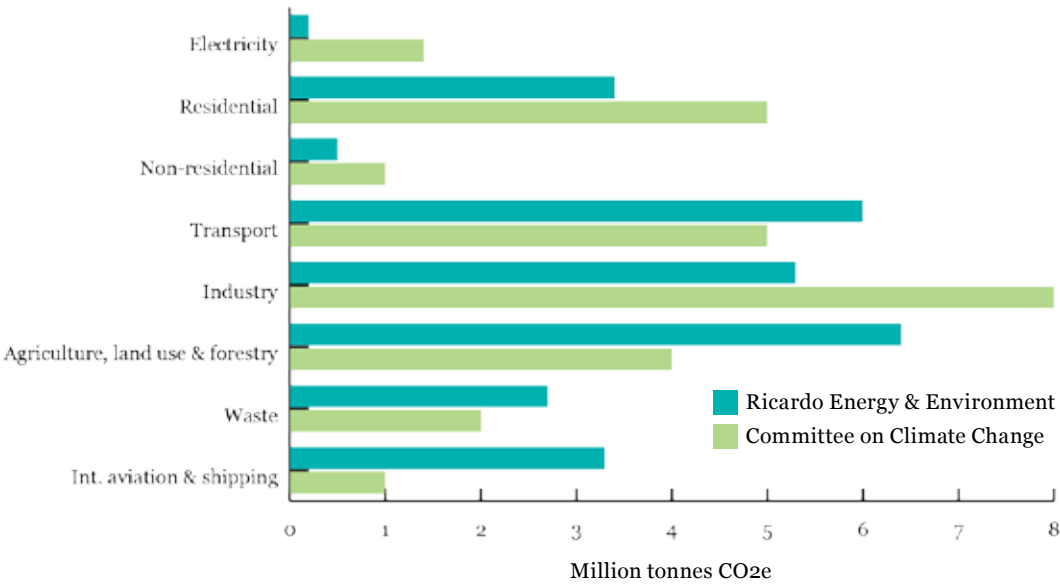
Three scenarios were modelled by Ricardo Energy & Environment using the MARKAL energy system model. The assumptions underpinning each scenario are explained below. The results presented in this summary are those of the ‘RPP Realistic’ scenario.

SCENARIO	DESCRIPTION	KEY ASSUMPTIONS
<b>BASELINE</b>	Emissions set to follow the trajectory set out in RPP2	<ul style="list-style-type: none"><li>All RPP2 policies (but not proposals) deliver their full expected emissions reduction.</li><li>Note that the 2030 Climate Change (Scotland) Act target is not achieved under this scenario</li></ul>
<b>RPP OPTIMISTIC</b>	Assumes all RPP2 policies are achieved and then the least cost set of additional measures is chosen to meet the 2030 target.	<ul style="list-style-type: none"><li>Policies in RPP2 are achieved</li><li>Other policies are chosen to achieve the 2030 emissions target at least cost</li><li>Electricity emissions in 2030 are 50g CO<sub>2</sub>/kWh</li><li>There is one 400MW CCS unit. No other new fossil fuel generation</li><li>Biomass limited to levels that can be sustainably produced in Scotland</li><li>Use of biofuels in transport capped at 5% of energy demand.</li></ul>
<b>RPP REALISTIC</b>	As RPP Optimistic, except some of the policies in RPP2 are assumed to only partially deliver, and some emissions in other sectors are higher than expected. This means that additional emissions reductions are needed, over and above those in “RPP Optimistic”.	<p>As above, except:</p> <ul style="list-style-type: none"><li>Only half of expected savings from tree planting (10,000 ha/year) are achieved</li><li>70% waste recycling target achieved in 2030 rather than 2025</li><li>International aviation emissions grow in line with UK Government central forecasts rather than staying flat</li><li>Smart meters, Green Deal and ECO deliver half expected savings in domestic sector</li><li>Heavy Goods Vehicles do not decarbonise</li></ul>

## RENEWABLE ENERGY TARGETS BY SECTOR, 2030

SCENARIO	OVERALL	ELECTRICITY	HEAT	TRANSPORT
<b>RPP OPTIMISTIC</b>	44%	145%	36%	11%
<b>RPP REALISTIC</b>	48%	143%	40%	18%

## 2030 EMISSIONS BY SECTOR



The chart above compares 2030 emissions in the Ricardo Energy & Environment ‘RPP realistic’ scenario with the Committee on Climate Change’s latest advice for Scotland<sup>21</sup>. Both models cap total emissions to 27.8 million tonnes CO<sub>2</sub>e in 2030, a reduction of 66% on 1990 levels<sup>22</sup>.

The model used by Ricardo Energy & Environment does not cover all sectors of the economy, only those relating to energy (electricity, heat, transport and industry). Emissions for sectors outside of the model (agriculture, waste, forestry and land use and international aviation) were taken from the Scottish Government’s RPP2 report, with some modified assumptions (see box overleaf). The Ricardo Energy & Environment scenario results have higher emissions from the agriculture, land use and forestry and aviation sectors than the CCC, which therefore means that emissions in the energy sectors reduce more significantly.



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